

MICROWAVES

IRRADIATING THE COMMUNITY

"The sun is our strongest natural source of microwaves. The microwave-oven-leakage standard set by the Bureau of Radiological Health is approximately one billion times higher than the total, entire microwave spectrum given off by the sun. It is appalling for these ovens to be permitted to leak at all, let alone for the oven advertisements to encourage our children to have fun by learning to cook with them."

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HIDDEN HAZARDS
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The statement opposite by Dr M.M. Zaret of the New York University Medical School was made to a US Senate committee hearing on microwaves in 1973.¹ By this time, in some urban areas of America, the level of manmade communication microwaves and high frequency radio waves in the environment was estimated to be from one hundred to two hundred million times the natural radio frequency background from the sun.²

Since the 1970s, the development of cheap solid-state devices for the generation of microwaves had resulted in a proliferation of generation equipment and use accompanied by a steady further increase in the environmental levels of this invisible pollution, sometimes termed 'electronic smog'.

This invisible smog penetrates our homes, workplaces and recreational areas, and is absorbed significantly by the human organism.

Literature has now accumulated which reveals a constellation of clues suggesting that persistent levels of microwave radiation vastly stronger than those occurring in nature are inimical to health.

Microwaves are part of the electromagnetic spectrum and are considered to be that radiation ranging in frequency from 300 million cycles per second (300 megahertz) to 300 billion cycles per second (or 300 gigahertz). This radiation corresponds to a wavelength range of 1 metre down to 1 millimetre. Electromagnetic energy in this region is non-ionising and this is quite different in terms of biological interaction compared with harmful x-rays and gamma rays. Microwaves are absorbed at the molecular level and manifest as changes in vibrational energy of the molecules or heat.

Microwaves are reflected by electrical conductors such as metals and certain obstacles. Consequently they can be focused into intense highly directional beams by antennas. Microwaves do not bend with the curvature of the earth. When long distance transmission is required, it is thus necessary to use repeaters that receive, amplify and re-transmit the signal. Typically repeaters are about 50 kilometres apart. Even the power transmission lines of the national electricity grid and their supporting towers may resonate with radio frequency radiation, thereby acting as repeaters, which re-radiate this energy into the environment.

One of the first uses of microwaves was in radar during World War II. Since the war microwaves have been utilised in air traffic control systems, military and police radar, television broadcast systems, long-distance telephone equipment, medical diathermy devices and microwave ovens. Industrial uses have also steadily increased. Microwaves are utilised for heating in rubber processing, plywood fabrication and paper and cardboard manufacture. These processes may utilise up to 1 million watts of microwave energy in individual factories. The ceramic, plastic manufacturing and leather industries also use microwaves, with other applications including the drying of textile bales, dehydration of fruit and the sterilisation of food.

As humans also absorb microwave radiation and heat up accordingly, the possibility of hazard from microwave exposure prompted researchers in the early 1950s to consider setting exposure guidelines.

SAFETY LEVELS - BASED ON A GUESS?

In 1953, H.P. Schwan of the University of Pennsylvania proposed that human exposure be limited to a maximum average power density of 100 watts per square metre or 10 milliwatts per square centimetre. Schwan's proposal, directed to the US Navy, was based on a calculation that exposure to this incident power should raise the temperature of the body by no more than 1°C, while power densities 10 times greater might produce heat damage. Thus, the proposed limit allowed a safety margin of about 10 times. The American National Standards Institute (ANSI) adopted this maximum exposure limit in 1966, with many Western nations adopting similar standards thereafter.³

Unfortunately, this maximum average exposure limit, which is still current in most Western countries, did not allow for the possibility of microwaves having athermal health effects. Subtle effects of low levels of microwave radiation which were not directly attributable to heating have been reported by researchers, mainly in Europe, since the 1950s but have been largely dismissed by prominent American researchers. However, as R. Bowers and J. Frey point out, "scepticism is not a sufficient basis for setting standards".⁴

It is revealing that athermal effects apparently were considered when the USSR established its maximum exposure standard of 10 microwatts per square centimetre per working day, a level 1000 times smaller than the US value.

A strong supporter of the high American exposure limit has been Professor S.M. Michaelson of the University of Rochester School of Medicine. In 1967 Michaelson had written: "The occasional reports of headache, lassitude, stomach-ache pains, sleeplessness, irritability, and other highly subjective symptoms among workers in the vicinity of microwave generating equipment have not been thoroughly investigated. These findings should not be ignored, as similar vague, mild, and undefined symptoms have been experienced in the course of microwave studies in this laboratory. Such symptoms could indicate a basic microwave effect."⁵

However, six years later at the 1973 Senate hearings he testified that there was no substantial evidence of injury to human beings from microwave radiation below the 10 milliwatt level. Over a decade later, despite a growing literature of subtle and harmful radio frequency radiation effects, a report by Michaelson still minimises the significance of much of this research and in his concluding remarks he states, "Depending upon the circumstances, what may be an adverse effect for one individual may be beneficial to another."⁶

Professor Michaelson's research in this instance and in earlier times was supported by the US Air Force.

This association of microwave research with the military was mooted by P. Brodeur in 1977⁷ as the main reason for the US maintaining its high exposure limit. R.O. Becker and G. Selden have pointed out:

"There were persuasive economic reasons why the 10,000 microwatt (=10 mW/cm²) standard was and still is defended at all costs. Lowering it would have curtailed the expansion of military EMR use and cut into the profits of the corporations that supplied the hardware. A reduced standard now would constitute an admission that the old one was unsafe, leading to liability for damage claims from ex-GIs and industrial workers."⁸

WHAT ARE THE HARMFUL EFFECTS OF MICROWAVES?

It would appear that it is obvious that if the human body is exposed to a high level of microwave radiation it would 'cook' much the same way as food 'cooks' in a microwave oven. However, microwave ovens use a specific frequency of radiation which is designed both to penetrate and heat. In communication systems a wide range of frequencies is used and the absorption of this radiation varies considerably with frequency.

The human body begins to significantly absorb electromagnetic radiation when the frequency exceeds about 15 megahertz. This absorption varies for different parts of the body with certain organs such as the eye and testes being particularly sensitive to microwave heating effects.

In the frequency range 70 to 100 megahertz, which overlaps the TV and FM radio broadcast frequencies, the human body acts as an efficient radiation antenna, strongly absorbing these wavelengths.⁹ This radio frequency radiation constitutes a major component of the electronic smog in our environment.

Although studies of the health effects of microwaves began in the 1940s,¹⁰ it was not until the mid-1960s that sufficient data had accumulated to alert observant researchers.

In 1964, M.M. Zaret reported that radio frequency radiation may produce capsular cataracts.¹¹ A few years later testicular damage was reported after repeated exposure to microwaves.¹² In both these cases high microwave intensities, such as those associated with military radar and which exceeded the 10 milliwatt limit, were involved.

What was more alarming was the steady trickle of reports that low levels of microwave exposure could produce a range of nervous and vascular symptoms. These were highlighted by Dr M.N. Sadchikova at a symposium in Warsaw in 1973 and later published.¹³ Sadchikova presented data of a study of 1180 workers who had been exposed to microwave radiation up to about 3 milliwatts per square centimetre compared with a control of 200 people who had not been exposed to microwaves. Sadchikova's results showed that among microwave exposed workers there was a significant increase in neurological complaints, such as heaviness in the head, fatigue, irritability, anxiety, insomnia, and partial loss of memory. Microwave workers also showed a significant increase in cardiovascular symptoms, such as a tendency to slow heartbeat, reduced blood pressure and reduced ventricular capacity. These symptoms which seem to characterise what has been called 'microwave radiation sickness' were produced by microwave levels well below the 100 milliwatt safe level of Western countries.¹⁴

The low safety margin of this standard is illustrated by reported cases where servicemen have accidentally been exposed to radar radiation a mere six to nine times the safety standard for a short time period and have been seriously affected.

In one case, a fifty-four-year-old man in good health was exposed to the radar for a mere 80 seconds. He experienced severe chest pain, vertigo and a heating sensation of the chest and head. Facial erythema (reddening of the skin) persisted for three days, stomach cramps, gritty eyes and other symptoms persisted for weeks, while insomnia and irritability remained for months.

The severity of the complaints peaked three months after the exposure and coincided with the diagnosis of arterial hypertension. A detailed medical examination five months later could reveal no secondary cause of the hypertension.

In a second case, a twenty-one-year-old healthy man sustained intermittent exposure for a mere 75 seconds at a similar intensity. He reported very similar initial symptoms. Four months after his exposure hypertension was again detected.¹⁵ A decade earlier M.M. Zaret had suggested a possible connection between radar exposure and hypertension.¹⁶

Commenting on a more recent radar exposure case, M.M. Zaret points out, "What is not fully appreciated by our profession is that repeated irradiation at subclinical levels can produce pathology that appears only after delay".¹⁷

The higher-than-expected incidence of cataracts in servicemen exposed to radar¹⁸ and in radio-linesmen¹⁹ is another example.

In the meantime studies with animals have revealed a whole range of microwave-induced effects including disturbance of bio-rhythms, increased protein synthesis of the liver, thymus and spleen, and the ability to recognise the presence of pulsed microwave radiation as a clicking sound heard in the head.²⁰ Low levels of microwave radiation have also been reported to induce cancer in test animals.²¹

GENETIC EFFECTS

The potentially devastating health effects of electronic smog are the genetic effects produced by radio frequency radiation.

Microwaves were first reported to cause chromosomal damage in 1959 by J.H. Heller and A.A. Teisceira-Pinto.²² The experiments were performed on garlic root tips, using very short pulses of radiation giving rise to a minimal thermal component. The effects noted mimicked those produced by ionising radiation. Subsequent studies by Heller are reported to have shown that low power microwave radiation could produce mutations in mammalian cells and in insects.²³ In the 1960s and 1970s researchers showed that protein, RNA and DNA absorb 65-75 gigahertz radiation, and that microwaves are able to interfere with repair mechanisms or even to induce gene mutations in bacteria.²⁴

In this same period S. Baranski and co-workers showed that chromosome aberrations are produced in human cells which have been irradiated with 3 gigahertz microwaves at power intensities below the safe level of 10 milliwatts per square centimetre.²⁵ A subsequent study reported in 1974 showed that fragmentation of nuclei as well as chromosome breakage occurred in human cells which had been exposed to microwaves of 2.95 gigahertz and power densities of 7 or 20 milliwatts per square centimetre.

While a number of studies have now reported that microwaves can produce foetal abnormalities in test animals (also known as teratogenic effects),²⁶ perhaps the most relevant evidence is the higher than expected incidence of Down's syndrome among the children of workers exposed to radar. In 1965 A.T. Sigler, from the Johns Hopkins University School of Public Health, reported on a study of ionising radiation exposure and microwave exposure of the parents of Down's syndrome children.

The results showed that although there were no discernible differences in exposures to x-rays or other ionising radiation for these fathers compared with the matched control group fathers, almost 10 per cent of the fathers of children with Down's syndrome had reported "intimate contact with radar", compared to slightly more than 3 per cent of the fathers of the control group.²⁷

A higher than expected incidence of congenital malformations among the children of helicopter pilots stationed at Fort Rucker, Alabama, was reported in the early 1970s and again linked to radar exposure.²⁸

More researchers are becoming convinced of these microwave health dangers. In 1988 M.M. Zaret offered the following warning to fellow medicos:

... the USSR established its maximum exposure standard of 10 microwatts per square centimetre per working day, a level 1000 times smaller than the US value.

"My analysis of newly acquired epidemiologic data implies that the mutagenic potential of non-ionising radiation should now be considered a factor for increased prevalence of Down's syndrome in Vernon Township, malignancies in Bourne, Falmouth and Sandwich--towns that surround the PAVE PAWS radar on Cape Cod in Massachusetts--and the otherwise unexplained increase in breast cancer-related mortality in white women younger than age 50 years, the group most involved with microwave ovens and video display terminals, both usually operated at breast height.

...we must become better acquainted with all forms of non-ionising radiation sickness."²⁹

MICROWAVE LEVELS IN THE ENVIRONMENT

This brings us to the issues of what are the levels of electronic smog in our environment, and how many of us are being affected. In 1972 Bowers and Frey drew attention to the already congested microwave channels in the New York metropolitan area with a coloured map in the report showing the approach to microwave saturation.³⁰

Later measurements of radio frequency radiation levels in several US cities by Environment Protection Agency (EPA) staff showed power density levels between 1 and 2.5 microwatts per square centimetre in 4 locations out of 72, the remainder being less than 1 microwatt. Another survey gave a measurement on a street corner in Washington DC as 3.5 microwatts per square centimetre with levels of 10, 66 and 97 microwatts per square centimetre near the tops of multi-storey buildings in New York, Chicago and Miami respectively.³¹ These power densities all exceed the Russian standard for maximum exposure.

A more recent 1986 EPA survey reports that while over 99 per cent of residents in 15 major US cities were exposed to less than 1 microwatt per square centimetre of AM, FM and TV frequencies, some locations are, however, exposed to much higher levels of radiation, such as revealed by a reading on the roof of the Sears Tower in Chicago which measured 230 microwatts per square centimetre. The EPA measurements also showed that at distance of 5 kilometres from large diameter tracking radars at airports or military bases, the power density levels of microwaves can be up to 100 microwatts per square centimetre.³²

Even at the 1 microwatt per square centimetre level this now ubiquitous manmade radio frequency radiation is now at a level millions of times higher than average levels occurring naturally at the earth's surface.

This raises one further issue. Do these increasing levels of electronic smog enhance the effects of ultraviolet radiation and contribute to the increasing incidence of skin cancer, the increase of which parallels the increase in environmental exposure to microwaves?

In addition the incidence of malignant melanoma seems to be lower in country areas than in cities where microwave radiation intensities are also higher. It is revealing to note that A. Leonard and co-workers in their evaluation of the mutagenic potential of microwaves comment:

"Although exposure to microwaves apparently does not damage the DNA at subthermal exposure levels, some results obtained with bacteria, yeast, cell cultures, animals in vivo or even man, however, indicate that microwaves might easily potentiate the damaging action of other DNA antagonist agents such as UV or chemicals."³³

MICROWAVE OVENS: IRRADIATING OUR FOOD AT HOME

The development of microwave ovens came as an expected spin-off from the rapidly developing post-war microwave technology, and the first commercial ovens were produced around 1962. These ovens use a magnetron tube to produce a microwave frequency of 2.45 gigahertz at an energy output of between 400 and 900 watts for a typical domestic unit. The oven power supply is designed to deliver 4000 volt negative pulses to the magnetron, which makes it the most dangerous power supply in any item of domestic equipment. The frequency chosen corresponds to the absorption peak for water, and thereby enables foods containing water to be heated quickly and efficiently. The microwaves are beamed from the magnetron into the oven compartment holding the food where they are contained. Microwave ovens are not permitted to leak microwaves at a power density level of more than 5 milliwatts per square centimetre at a distance of 5 centimetres from the outside of the oven. Thus small leaks below this level may occur and substantially contribute to the electronic smog in the home or office. Medical hazards reported to be associated with microwave ovens include burns, cataract formation, neurologic injury and pacemaker dysfunction.³⁴

Despite the publication of these reports, microwave oven sales have continued to soar, reflecting the ever-increasing hold of technology on society. In 1987, 11 per cent of West German, 35 per cent of English and 66 per cent of US households had microwave ovens. It has been forecast that the percentage of microwave households in the US will rise to 90 per cent by the mid-1990s.³⁵ These rises parallel the increasing percentage of women in the work force and decreasing family size in many Western countries. In the words of M. Doyle, president of The Consumer Network in the United States, "There's a new kind of eater, buyer and user evolving, and there's a revolution against kitchen work and any kind of hassle anywhere. Time is so precious that "quality time" is afforded with our families not in front of the warm hearth, but around the microwave."³⁶

WHAT WE CAN DO

It is difficult to entirely avoid exposure to microwave radiation. Local government agencies may be able to provide details of microwave high intensity corridors. Living in these corridors and near radar should be avoided.

There are some other things you can do to minimise the health risk to you and your children. If you have a microwave oven and intend to go on using it, have it checked immediately and regularly for leaks. Microwave oven doors are especially prone to leakage. Do not open the door while the oven is on. Try to avoid microwave cooking of frozen foods and commercially prepared dinners whenever possible.

One additional worry is that the most recently targeted market segment for microwave-ready cuisine is young children, with some microwave cooks reported to be only five or six years old. While the children's microwave meal market in the US already constitutes in excess of \$100 million in annual sales, the health cost to the population may be far greater. Exposing young, still developing children to low level microwaves from potentially leaky or misused ovens is a business too risky to be in.

Similarly, the health risks for young children associated with the long-term eating of microwaved food are unknown and may prove to be yet another disaster in the name of economic growth and blinded commercialism. Given the unknown variables in this matter, we believe it prudent for parents to discourage growing children from using microwaves and to minimise the quantity of microwaved food eaten.



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